TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
Department of Mechanical & Automotive Engineering
UNIVERSITY EXAMINATION FOR:
BSc. Mechanical Engineering
EMG 2302 **:** Engineering Thermodynamics II
END OF SEMESTER EXAMINATION
SERIES: DECEMBER 2016
TIME: 2 HOURS
DATE: Pick Date **Dec 2016**

Instruction to Candidates:

You should have the following for this examination

- *Answer booklet*
- *Non-Programmable scientific calculator*

This paper consists of **FIVE** questions. Attempt question **ONE** and any other **TWO** questions.

Maximum marks for each part of a question are as shown.

Do not write on the question paper.

Question One

a) Explain the following terms
   i. Available Energy
   ii. Unavailable Energy (4marks)

b) Derive the equation for the decrease in available energy when heat is transferred through a finite temperature different. (9 marks)

c) A system at 500K receives 7200kJ/min from a source at 1000K.The temperature of the atmosphere IS 300K.Assuming that the temperatures of the system and source remain constant during heat transfer. Calculate
   i. The entropy produced during heat transfer

ii. Decrease in available energy after heat transfer. (7 marks)

Question Two

a) Define the following terms
   i. Mole fraction
   ii. Partial pressure. (3 marks)

b) 1 kg of air at 1 bar and $50^{O}C$ is compressed adiabatically to a pressure of 5 bar. The air is then expanded at constant pressure to the initial volume. Determine work transfer and heat transfer for the whole path.
(5 marks)

c) A mixture of ideal gases consists of 2.5 kg of N2 and 4.5 Kg of carbon dioxide at a pressure of 4 bar and a temperature of $25^{O}c$.Find
   i. The mole fraction of each constituent
   ii. Equivalent of molecular weight of the mixture
   iii. Equivalent gas constant of the mixture
   iv. Partial pressure and partial volumes
   v. The volume and density of the mixture
   vi. C_p and C_v of the mixtures [take ɣ=1.285 for CO_2 and ɣ=1.4 for N_2)
(12 marks)

Question Three

a) Define the following terms
   i. Dry air
   ii. Saturated air
   iii. Wet-bulb temperature
   iv. Dry- bulb temperature (8 marks)

b) Explain the adiabatic saturation process. (6 marks)

c) The air supplied to a room of a building in cold season is to be at $17^{o}C$ and a relative humidity of 60%.If the barometric pressure is 1.01325 bar .Calculate
   i. Specific humidity.
   ii. The dew point under these conditions. (6 marks)

Question Four

a) Describe a regenerative cycle with a single feed water heater and show it's efficiency
(12 marks)

b) In a single-heater regenerative cycle the steam enters the turbine at 30 bar, 400°C and the exhaust pressure is 0.10 bar. The feed water heater is a direct contact type which operates at 5 bar. Find

i. :The efficiency and the steam rate of the cycle.
ii. The increase in mean temperature of heat addition, efficiency and steam rate as compared to the Rankine cycle (without regeneration).Pump work may be neglected.

Question Five

a) Explain the various operations of Rankine cycle and derive it's efficiency.

(10 marks)

b) In Rankine cycle, the steam at inlet to turbine is saturated at a pressure of 35 bar and the exhaust pressure is 0.2 bar. Calculate

i. The pump
ii. Turbine work
iii. Rankine efficiency
iv. Condenser heat flow
v. The dryness at the of expansion. (10 marks)